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TITLE: Manufacture of flat ceramic board - involves subjecting ceramic board formed with ceramic green sheets to blasting process, after pressure application and baking process, using projection material set with predetermined hardness

PATENT-ASSIGNEE:

ASSIGNEE

CODE

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SUMIN

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ABSTRACTED-PUB-NO: JP10218675A

BASIC-ABSTRACT:

The method involves subjecting a ceramic board (11) formed with ceramic green sheets (12) on either sides, to pressure and baking process. The hardness of ceramic green sheet is set equal to or less than that of ceramic board. After pressure application and baking process, the ceramic board formed with ceramic green sheets is subjected to blast process during which the ceramic green sheets are removed. The hardness of projection material employed for blast process is set equal to or more than that of ceramic green sheets.

ADVANTAGE - Improves removal property of ceramic green sheets. Improves flat property of ceramic board. Enables to manufacture ceramic board of sufficient efficiency and quality.

CHOSEN-DRAWING: Dwg.1/1

TITLE-TERMS: MANUFACTURE FLAT CERAMIC BOARD SUBJECT CERAMIC BOARD FORMING CERAMIC GREEN SHEET BLAST PROCESS AFTER PRESSURE APPLY BAKE PROCESS PROJECT MATERIAL SET PREDETERMINED HARD

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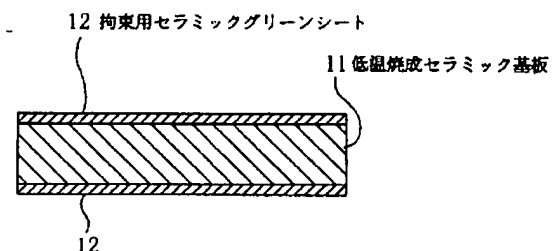
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(54) 【発明の名称】 セラミック基板の製造方法

(57) 【要約】

【課題】 加圧焼成後の拘束用セラミック層の除去性と焼成基板の平坦性とを共に良好にする。

【解決手段】 焼成前の低温焼成セラミック基板11の両面に宛がう拘束用セラミックグリーンシート12のセラミック材料(以下「拘束用セラミック」という)の硬度を低温焼成セラミック基板11の硬度と同等若しくはそれ以下の硬度に設定して加圧焼成する。次工程のブラスト処理に用いる投射材の硬度を、拘束用セラミックの硬度と同等若しくはそれ以上の硬度で且つ低温焼成セラミック基板11の硬度と同等若しくはそれ以下の硬度に設定して、焼成基板の表面の拘束用セラミックをブラスト処理で除去する。これにより、加圧焼成後に拘束用セラミックを能率良く除去できると共に、投射材によって基板表面が削り取られてしまうことを防止できて、基板表面の平坦性を良好にできる。



【特許請求の範囲】

【請求項1】 焼成前のセラミック基板の両面に該セラミック基板の焼結温度では焼結しない拘束用セラミック層を宛がって加圧しながら焼成し、焼成後に該拘束用セラミック層をブラスト処理で除去してセラミック基板を製造する方法において、前記拘束用セラミック層の硬度を、前記セラミック基板の硬度と同等若しくはそれ以下の硬度に設定して加圧焼成すると共に、前記ブラスト処理に用いる投射材の硬度を、前記拘束用セラミック層の硬度と同等若しくはそれ以上の硬度で且つ前記セラミック基板の硬度と同等若しくはそれ以下の硬度に設定してブラスト処理することを特徴とするセラミック基板の製造方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、焼成前のセラミック基板の両面に拘束用セラミック層を宛がって加圧焼成するセラミック基板の製造方法に関するものである。

【0002】

【従来の技術】近年、低温焼成セラミック基板を焼成する際に、基板の面方向の焼成収縮を小さくして基板寸法精度を向上させるために、焼成前の低温焼成セラミック基板の両面に拘束用アルミナグリーンシートを宛がい、その上から加圧しながら低温焼成セラミック基板を焼成した後、その焼成基板の両面に付着した未焼結の拘束用アルミナグリーンシートの残留物（拘束用アルミナグリーンシートは焼成の過程で溶剤や樹脂バインダが飛散してアルミナ粉体として残る）を除去して低温焼成セラミック基板を製造する加圧焼成法が提案されている。

【0003】

【発明が解決しようとする課題】上記加圧焼成法では、加圧焼成終了後に、焼成基板の両面に付着した未焼結の拘束用アルミナグリーンシートの残留物（アルミナ粉体）を除去する方法として湿式又は乾式のブラスト処理が用いられる。このブラスト処理は、微小の投射材を高圧水流又は高圧空気流等によって基板表面の拘束用アルミナに噴射して、該拘束用アルミナを除去する。この際、投射材の硬度が低い（柔らかい）と、除去能力が低下して、基板表面の拘束用アルミナを完全に除去することが困難となるため、投射材は、拘束用アルミナに近い硬度のものが使用される。低温焼成セラミック（ガラスセラミック）は、アルミナと比較して柔らかいため、拘束用アルミナの除去に用いる投射材の硬度が低温焼成セラミック基板より硬くなってしまう。このため、投射材の投射圧により低温焼成セラミック基板の表面が削り取られてしまい、基板表面の平坦性が低下して、基板品質が低下する欠点がある。

【0004】本発明はこのような事情を考慮してなされたものであり、従ってその目的は、加圧焼成後の拘束用セラミック層の除去性と焼成基板表面の平坦性とを共に

良好にすることができて、品質の良いセラミック基板を加圧焼成法で能率良く製造することができるセラミック基板の製造方法を提供することにある。

【0005】

【課題を解決するための手段】上記目的を達成するために、本発明のセラミック基板の製造方法は、加圧焼成するセラミック基板の両面に宛がう拘束用セラミック層の硬度を、前記セラミック基板の硬度と同等若しくはそれ以下の硬度に設定して、加圧焼成し、次工程のブラスト処理に用いる投射材の硬度を、前記拘束用セラミック層の硬度と同等若しくはそれ以上の硬度で且つ前記セラミック基板の硬度と同等若しくはそれ以下の硬度に設定して、焼成基板の表面の拘束用セラミック層をブラスト処理で除去する。この方法では、ブラスト処理で用いる投射材の硬度が拘束用セラミック層の硬度と同等若しくはそれ以上の硬度であるため、加圧焼成後に拘束用セラミック層を能率良く除去できる。しかも、投射材の硬度は、セラミック基板の硬度と同等若しくはそれ以下の硬度であるため、ブラスト処理時に投射材によってセラミック基板の表面が削り取られてしまうことを防止できる。

【0006】

【発明の実施の形態】図1に示すように、加圧焼成時には、低温焼成セラミック基板11の両面に拘束用セラミックグリーンシート12（拘束用セラミック層）を宛がって、その上から加圧しながら800～1000℃で焼成する。

【0007】低温焼成セラミック基板11は、単層基板でも良いが、グリーンシート積層法により複数枚のグリーンシートを積層した多層基板でも良い。低温焼成セラミック基板11の材料としては、例えば、 $\text{CaO-SiO}_2-\text{Al}_2\text{O}_3-\text{B}_2\text{O}_3$ 系ガラス50～65重量%（好ましくは60重量%）とアルミナ50～35重量%（好ましくは40重量%）との混合物を用いる。この他、 $\text{MgO-SiO}_2-\text{Al}_2\text{O}_3-\text{B}_2\text{O}_3$ 系ガラスとアルミナ粉末との混合物、 $\text{SiO}_2-\text{B}_2\text{O}_3$ 系ガラスとアルミナとの混合物、 $\text{PbO-SiO}_2-\text{B}_2\text{O}_3$ 系ガラスとアルミナとの混合物、ソーダライト系結晶化ガラス等の800～1000℃で焼成できる低温焼成セラミック材料を用いても良い。

【0008】低温焼成セラミック基板11が多層基板の場合には、各層のグリーンシートを積層する前に、各層のグリーンシートのビアホールに、 Ag 、 Ag/Pd 、 Au 、 Ag/Pt 、 Cu 等の低融点金属の導体ペーストを充填し、内層に積層されるグリーンシートには、同じ低融点金属の導体ペーストを使用して内層導体パターンをスクリーン印刷する。更に、表層のグリーンシートには、表層導体パターンを Ag 、 Ag/Pd 、 Au 、 Ag/Pt 、 Cu 等の低融点金属の導体ペーストを用いてスクリーン印刷する。この印刷工程後に、各層のグリーン

シートを積層して加熱圧着して一体化する。尚、表層導体パターン印刷は、加圧焼成後に行っても良い。

【0009】一方、拘束用セラミックグリーンシート12は、低温焼成セラミック基板11の硬度と同等若しくはそれ以下の硬度のセラミック、例えばMgO、ZrO₂を用いてテープ成形されている。ちなみに、低温焼成セラミック基板11のモース硬度が8程度であるのに対し、MgOのモース硬度は6、ZrO₂のモース硬度は8である（モース硬度は大きいほど硬い）。MgOやZrO₂は、低温焼成セラミック基板11の焼結温度（800～1000℃）では焼結しない。しかも、MgOやZrO₂は、低温焼成セラミック基板11表面のアルカリ成分に対して耐蝕性があり、加圧焼成時に低温焼成セラミック基板11の表面に融着せず、加圧焼成後のブラスト処理時に低温焼成セラミック基板11から除去しやすいという特徴がある。尚、拘束用セラミックグリーンシート12の成形に用いるMgO、ZrO₂は、アルカリ成分に対する耐蝕性を高めるために、不純物の含有量が少ない方が良く、例えば99.90%以上の高純度のMgO、ZrO₂を用いることが好ましい。

【0010】また、拘束用セラミックグリーンシート12の成形に用いるMgO、ZrO₂等のセラミック粉末の粒径が大きいと、拘束用セラミックグリーンシート12の表面に出来る凹凸が大きくなり、加圧焼成時に拘束用セラミックグリーンシート12の圧着によって低温焼成セラミック基板11の表面に転写される凹凸が大きくなるため、セラミック粉末の平均粒径が0.1～10μmのものを用いることが好ましく、より好ましくは、平均粒径が0.2～5μm程度のセラミック粉末を用いると良い。

【0011】このセラミック粉末にバインダ樹脂（例えばPVB、アクリル系やニトロセルロース系の樹脂）、溶剤（例えばトルエン、キシレン、ブタノール）及び可塑剤（例えばアミン系有機物、DOA）を配合して、十分に攪拌混合してスラリーを作製し、このスラリーを用いてドクターブレード法等で拘束用セラミックグリーンシート12をテープ成形する。

【0012】この場合、セラミック粉末に対するバインダ樹脂、溶剤、可塑剤の配合比は、セラミック粉末に対する重量比で、バインダ樹脂が25重量%以下、溶剤が50重量%以下、可塑剤が0.5重量%以上であることが好ましい。

【0013】つまり、バインダ樹脂の配合量が多すぎると、焼成時の加圧力により拘束用セラミックグリーンシート12の焼成延びが大きくなりすぎるため、セラミック粉末に対するバインダ樹脂の配合比を25重量%以下とすることで、焼成延びを適正範囲内に抑える。

【0014】また、溶剤の配合量が多すぎると、拘束用セラミックグリーンシート12のテープ成形後の乾燥時の収縮量が大きくなりすぎるため、セラミック粉末に対

する溶剤の配合比を50重量%以下とすることで、乾燥時の収縮量を適正範囲内に抑える。

【0015】また、可塑剤の配合量が少なすぎると、溶剤と分離して十分な可塑性が得られなくなるため、セラミック粉末に対する可塑剤の配合比を0.5重量%以上とすることで、溶剤と十分に混合させて、必要な可塑性を確保する。

【0016】以上のような組成の拘束用セラミックグリーンシート12を用いて低温焼成セラミック基板11を加圧焼成する場合には、図1に示すように、低温焼成セラミック基板11の両面に拘束用セラミックグリーンシート12を宛がって、その上から2～20kgf/cm²の圧力で加圧しながら、低温焼成セラミック基板11の焼結温度である800～1000℃（好ましくは900℃）で焼成する。この際、低温焼成セラミック基板11両面に積層された拘束用セラミックグリーンシート12（MgO、ZrO₂等）は、1500℃以上に加熱しないと焼結しないので、800～1000℃で焼成すれば、拘束用セラミックグリーンシート12は未焼結のまま残される。但し、焼成の過程で、拘束用セラミックグリーンシート12中の溶剤や樹脂バインダが飛散してセラミック粉体として残る。

【0017】加圧焼成後、低温焼成セラミック基板11の両面に付着した拘束用セラミックグリーンシート12の残留物（セラミック粉体）を湿式ブラスト（ウォータージェット）又は乾式ブラストにより除去する。この湿式又は乾式のブラスト処理に用いる投射材は、拘束用セラミックグリーンシート12のセラミック材料の硬度と同等若しくはそれ以上の硬度で且つ低温焼成セラミック基板11の硬度と同等若しくはそれ以下の硬度のセラミック粉体を用いる。例えば、拘束用セラミックグリーンシート12がMgO（モース硬度：6）の場合には、投射材はMgOの粉体を用い、また、拘束用セラミックグリーンシート12がZrO₂（モース硬度：8）の場合には、投射材はMgO又はZrO₂の粉体を用いる。

【0018】湿式ブラストでは、投射材を高圧水流によって除去対象部位に噴射し、乾式ブラストでは、投射材を高圧空気流によって除去対象部位に噴射し、低温焼成セラミック基板11の両面に付着した拘束用セラミックグリーンシート12の残留物（セラミック粉体）を除去する。例えば、湿式ブラスト（ウォータージェット）の場合には、投射材の粒径を例えば10μmとし、投射圧を例えば4.5kgf/cm²とし、製品の搬送速度を例えば0.2m/分として、投射材を噴射する。この条件は、一例であり、適宜変更しても良いことは言うまでもない。

【0019】ブラスト処理後、低温焼成セラミック基板11の表面をバフ研磨して仕上げる。このバフ研磨は、研磨輪（バフ）を用い、その表面に研磨剤（例えばSiC）を付けて、研磨輪を例えば2000rpm程度で回

転させ、この研磨輪を低温焼成セラミック基板11の表面に押し付けて仕上げ研磨する（仕上げ面粗さ：＃1500相当）。

【0020】バフ研磨終了後、めっき前処理としてアルカリ脱脂と塩酸洗浄を行った後、低温焼成セラミック基板11の表面の導体にNi/Auめっきを施す。これにて、低温焼成セラミック基板11の製造工程が完了する。

*【0021】

【実施例】本発明者は、加圧焼成した低温焼成セラミック基板をブラスト処理する際に、拘束用セラミック層の硬度と投射材の硬度が拘束用セラミック層の除去性と基板表面の平坦性に与える影響を考察するブラスト試験を行ったので、その試験結果を次の表1に示す。

【0022】

*【表1】

サンプル No.	拘束用セラミック		ブラスト投射材		除去性	平坦性
	材料	モース硬度	材料	モース硬度		
1	Al ₂ O ₃	9	CaCO ₃	3	×	測定不可
2	Al ₂ O ₃	9	MgO	6	×	測定不可
3	Al ₂ O ₃	9	Al ₂ O ₃	9	○	×
4	ZrO ₂	8	CaCO ₃	3	×	測定不可
5	ZrO ₂	8	MgO	6	△	○
6	ZrO ₂	8	ZrO ₂	8	○	○
7	MgO	6	CaCO ₃	3	×	測定不可
8	MgO	6	MgO	6	○	○
9	MgO	6	ZrO ₂	8	○	○

【0023】この試験で加圧焼成した低温焼成セラミック基板のモース硬度は8である。拘束用セラミックの材料は、サンプルNo. 1～3ではアルミナ（モース硬度：9）、サンプルNo. 4～6ではZrO₂（モース硬度：8）、サンプルNo. 7～9ではMgO（モース硬度：6）を用いた。

【0024】また、投射材の材料は、サンプルNo. 1, 4, 7ではCaCO₃（モース硬度：3）、サンプルNo. 2, 5, 8ではMgO（モース硬度：6）、サンプルNo. 6, 9ではZrO₂（モース硬度：8）、サンプルNo. 3ではアルミナ（モース硬度：9）を用いた。ブラスト法は、湿式ブラスト（ウォータージェット）を用いた。

【0025】この試験結果から、投射材のモース硬度が拘束用セラミックのモース硬度よりも低い場合（サンプルNo. 1, 2, 4, 5, 7）は、除去能力が悪く、基板表面の拘束用セラミックを完全に除去することができず、基板表面に拘束用セラミックが残ってしまった。尚、拘束用セラミックがZrO₂（モース硬度：8）の場合、低温焼成セラミック基板との型離れが良いため、サンプルNo. 5のように、投射材の硬度が拘束用セラミックの硬度より少し低くても、除去性は比較的良好であるが、今回の試験条件では、基板表面に一部の拘束用セラミックが残ってしまった。

【0026】これに対し、投射材のモース硬度が拘束用※50

※セラミックのモース硬度と同等若しくはそれ以上の場合（サンプルNo. 3, 6, 8, 9）は、除去性が良好であり、基板表面の拘束用セラミックを完全に除去することができた。この試験結果から、除去性を良好にするには、投射材の硬度が拘束用セラミックの硬度と同等若しくはそれ以上であれば良いことが分かる。

【0027】また、ブラスト処理後の低温焼成セラミック基板の平坦性については、拘束用セラミックの除去不良が生じたサンプルNo. 1, 2, 4, 7は、基板表面が平坦にならないことは明らかであり、拘束用セラミックの除去残りのために測定不可であった。尚、拘束用セラミックがZrO₂の場合には、低温焼成セラミック基板との型離れが良いため、サンプルNo. 5（投射材がMgO）のように、基板表面に一部の拘束用セラミックが残っている場合でも、拘束用セラミックの残量が少なければ、バフ研磨により拘束用セラミックを完全に除去することができ、基板表面の平坦性を確保できる。

【0028】一方、ブラスト処理による除去性が良好な場合でも、基板表面の平坦性が必ずしも良好になるとは限らない。すなわち、サンプルNo. 3では、投射材として用いたアルミナ（モース硬度：9）が低温焼成セラミック基板（モース硬度：8）よりも硬い材料であるため、投射材の投射圧により基板表面が削り取られてしまい、基板表面の平坦性が不良となった。

【0029】これに対し、投射材の硬度が低温焼成セラ

ミック基板の硬度と同等若しくはそれ以下の硬度であるサンプルNo. 6, 8, 9では、ブラスト処理による基板表面の削り取りが発生せず、基板表面の平坦性が良好であった。この試験結果から、基板表面の平坦性を良好にするには、投射材のモース硬度が低温焼成セラミック基板の硬度と同等若しくはそれ以下の硬度であれば良いことが分かる。

【0030】以上の試験結果を総合的に考察すると、拘束用セラミック層の除去性と基板表面の平坦性との双方を良好にするためには次の条件を満たす必要がある。拘束用セラミック層の硬度 \leq 投射材の硬度 \leq 低温焼成セラミック基板の硬度この条件を満たせば、拘束用セラミック層の除去性と基板表面の平坦性とを共に満足することができる。

【0031】

【発明の効果】以上の説明から明らかなように、本発明のセラミック基板の製造方法では、拘束用セラミック層

の硬度 \leq 投射材の硬度 \leq セラミック基板の硬度に設定して、加圧焼成した後、ブラスト処理により基板表面の拘束用セラミック層を除去するようにしたので、加圧焼成後に拘束用セラミック層を能率良く除去できると共に、投射材によってセラミック基板の表面が削り取られてしまうことを防止できて、基板表面の平坦性を良好にでき、品質の良いセラミック基板を加圧焼成法で能率良く製造することができる。

【図面の簡単な説明】

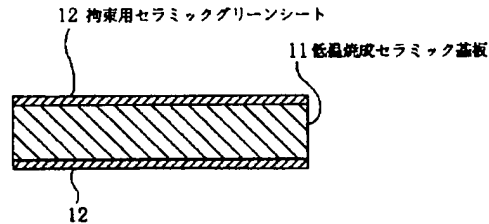
10 【図1】本発明の一実施形態における加圧焼成時の拘束用セラミックグリーンシートと低温焼成セラミック基板との積層状態を示す縦断面図

【符号の説明】

11…低温焼成セラミック基板（セラミック基板）、1

2…拘束用セラミックグリーンシート（拘束用セラミック層）。

【図1】



PATENT ABSTRACTS OF JAPAN

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(71)Applicant : SUMITOMO KINZOKU ELECTRO
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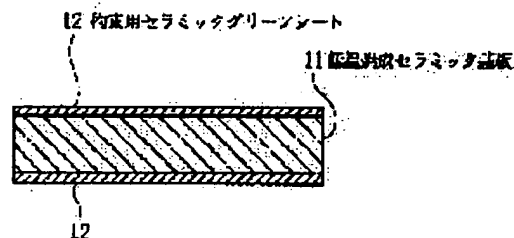
(72)Inventor : NAKANO SATORU

(54) PRODUCTION OF CERAMIC SUBSTRATE

(57)Abstract:

PROBLEM TO BE SOLVED: To improve both removal performances of a ceramic layer for restraint after baking under pressure and flatness of baked substrate.

SOLUTION: Baking under pressure is carried out by setting hardness of a ceramic material of a ceramic green sheet 12 for restraint (ceramic for restraint for short) to be applied to both sides of a low-temperature baked ceramic substrate 11 before baking equal to or lower than that of the low-temperature baked ceramic substrate 11. The hardness of a projection material to be used in the following blast treatment is set to a hardness equal to or higher than that of the ceramic for restraint and equal to or lower than that of the low-temperature baked ceramic substrate 11 to remove the ceramic for restraint on the surface of a baked substrate by blast treatment. Consequently, the ceramic for restraint can be efficiently removed after baking under pressure and shaving off of the substrate surface by the projection material is prevented to improve flatness of the surface of the substrate.



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CLAIMS

[Claim(s)]

[Claim 1] It calcinates, pressurizing, the ceramic layer for a restraint which is not sintered at the sintering temperature of this ceramic substrate to both sides of the ceramic substrate before baking -- ** -- In the technique of removing this ceramic layer for a restraint by blast processing, and manufacturing a ceramic substrate after baking While the degree of hardness of the aforementioned ceramic layer for a restraint is set as the degree of hardness of the aforementioned ceramic substrate, an EQC, or the degree of hardness not more than it and carries out pressurization baking The manufacture technique of the ceramic substrate characterized by being the degree of hardness of the aforementioned ceramic layer for a restraint, an EQC, or a degree of hardness beyond it, and setting the degree of hardness of the projection material used for the aforementioned blast processing as the degree of hardness of the aforementioned ceramic substrate, an EQC, or the degree of hardness not more than it, and carrying out blast processing.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention -- both sides of the ceramic substrate before baking -- the ceramic layer for a restraint -- ** -- it is related with the manufacture technique of the ceramic substrate which carries out pressurization baking

[0002]

[Description of the Prior Art] In case a low-temperature baking ceramic substrate is calcinated in recent years, in order to make small burning shrinkage of the orientation of a field of a substrate and to raise a substrate dimensional accuracy The alumina green sheet for a restraint of ** is in both sides of the low-temperature baking ceramic substrate before baking. After calcinating a low-temperature baking ceramic substrate, pressurizing from moreover, The method [calcinate / pressurization] for removing the residue (a solvent and a resin binder dispersing in process of baking, and the alumina green sheet for a restraint remaining as alumina fine particles) of the non-sintered alumina green sheet for a restraint adhering to both sides of the baking substrate, and manufacturing a low-temperature baking ceramic substrate is proposed.

[0003]

[Problem(s) to be Solved by the Invention] By the above-mentioned pressurization calcinating method, wet or dry-type blast processing is used after a pressurization baking end as technique of removing the residue (alumina fine particles) of the non-sintered alumina green sheet for a restraint adhering to both sides of a baking substrate. This blast processing injects minute projection material to the alumina for a restraint on the front face of a substrate by the hyperbaric-pressure stream or the hyperbaric-pressure airstream, and removes this alumina for a restraint. in this case, the degree of hardness of projection material -- being low (soft) -- elimination capacity declines, and since it becomes difficult to remove completely the alumina for a restraint on the front face of a substrate, the thing of the degree of hardness with the projection material near the alumina for a restraint is used As for a low-temperature baking ceramic (glass ceramic), as compared with an alumina, since it is soft, the degree of hardness of the projection material used for elimination of the alumina for a restraint will become harder than a low-temperature baking ceramic substrate. For this reason, there is a fault to which the front face of a low-temperature baking ceramic substrate will be shaved off by ***** of projection material, the flat nature on the front face of a substrate falls to, and a substrate quality falls.

[0004] It is in this invention being made in consideration of such a situation, therefore the purpose both being able to make good the elimination nature of the ceramic layer for a restraint after pressurization baking, and flat nature of a baking substrate front face, and offering the manufacture technique of a ceramic substrate that a quality ceramic substrate can be well manufactured by the pressurization calcinating method.

[0005]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the manufacture technique of the ceramic substrate of this invention ** obtains to both sides of the ceramic substrate which carries out pressurization baking, and the degree of hardness of the ceramic layer for a restraint is set as the degree of hardness of the aforementioned ceramic substrate, an EQC, or the degree of hardness not more than it. Carry out pressurization baking, and are the degree of hardness of the aforementioned ceramic layer for a restraint, an EQC, or a degree of hardness beyond it, and the degree of hardness of the projection material used for blast processing of the following process is set as the degree of hardness of the aforementioned ceramic substrate, an EQC, or the degree of hardness not more than it. The ceramic layer for a restraint of the front face of a baking substrate is removed by blast processing. By this technique, since the degree of hardness of the projection material used by blast processing is the degree of hardness of the ceramic layer for a restraint, an EQC, or a degree of hardness beyond it, the ceramic layer for a restraint is well removable after pressurization baking. And since the degree of hardness of projection material is the degree of hardness of a ceramic substrate, an EQC, or a degree of hardness not more than it, it can prevent that the front face of a ceramic substrate will be shaved off by projection material at the time of blast processing.

[0006]

[Embodiments of the Invention] it is shown in drawing 1 -- as -- the time of pressurization baking -- both sides of the low-temperature baking ceramic substrate 11 -- the ceramic green sheet for a restraint 12 (ceramic layer for a restraint) -- ** -- it calcinates at 800-1000 degrees C, pressurizing from it

[0007] Although a monolayer substrate is sufficient as the low-temperature baking ceramic substrate 11, the multilayer substrate

which carried out the laminating of the green sheet of two or more sheets by the green-sheet laminated layers method is sufficient as it. As a material of the low-temperature baking ceramic substrate 11, mixture (50 - 65 % of the weight (preferably 60 % of the weight) of CaO-SiO₂-aluminum₂ O₃-B₂ O₃ system glass and 50 - 35 % of the weight (preferably 40 % of the weight) of aluminas) is used, for example. In addition, MgO-SiO₂-aluminum₂ O₃-B₂ O₃ The mixture of system glass and alumina powder, the mixture of SiO₂-B₂ O₃ system glass and an alumina, and PbO-SiO₂-B₂ O₃ You may use the low-temperature baking ceramic material which can be calcinated at 800-1000 degrees C, such as the mixture of system glass and an alumina, and a cordierite system glass ceramics.

[0008] before carrying out the laminating of the green sheet of each class, when the low-temperature baking ceramic substrate 11 is a multilayer substrate -- the beer hall of the green sheet of each class -- the conductor of low melting point metals, such as Ag, Ag / Pd, Au and Ag / Pt, Cu, -- the conductor of the same low melting point metal as the green sheet by which is filled up with a paste and a laminating is carried out to an inner layer -- a inner layer conductor pattern is screen-stenciled using a paste furthermore -- a surface green sheet -- a cortex conductor pattern -- the conductor of low melting point metals, such as Ag, Ag / Pd, Au and Ag / Pt, Cu, -- it screen-stencils using a paste The laminating of the green sheet of each class is carried out, and this printer does heating sticking by pressure, and unites with behind. In addition, you may perform printing of a cortex conductor pattern after pressurization baking.

[0009] On the other hand, the ceramic green sheet for a restraint 12 is the degree of hardness of the low-temperature baking ceramic substrate 11, an EQC, or the ceramic, MgO and ZrO₂, of the degree of hardness not more than it. The tape forming is used and carried out. [for example,] The Mohs hardness of MgO is 6 and ZrO₂ to incidentally the Mohs hardness of the low-temperature baking ceramic substrate 11 being about eight. Mohs hardness is 8 (the larger value of Mohs hardness is harder). MgO and ZrO₂ It does not sinter at the sintering temperature (800-1000 degrees C) of the low-temperature baking ceramic substrate 11. And MgO and ZrO₂ There is corrosion resistance to the alkali component of low-temperature baking ceramic substrate 11 front face, it does not weld to the front face of the low-temperature baking ceramic substrate 11 at the time of pressurization baking, but there is the characteristic feature of being easy to remove from the low-temperature baking ceramic substrate 11 at the time of blast processing after pressurization baking. In addition, MgO and ZrO₂ which are used for molding of the ceramic green sheet for a restraint 12 In order to raise the corrosion resistance over an alkali component, the direction with few contents of an impurity is good, for example, it is MgO of 99.90% or more of a high grade, and ZrO₂. Using is desirable.

[0010] Moreover, if the particle size of the ceramic powder used for molding of the ceramic green sheet for a restraint 12, such as MgO and ZrO₂, is large Since the irregularity made on the front face of the ceramic green sheet for a restraint 12 becomes large and the irregularity imprinted by sticking by pressure of the ceramic green sheet for a restraint 12 on the front face of the low-temperature baking ceramic substrate 11 at the time of pressurization baking becomes large, It is desirable to use that whose mean particle diameter of ceramic powder is 0.1-10 micrometers, and it is good to use more preferably the ceramic powder whose mean particle diameter is about 0.2-5 micrometers.

[0011] A binder resin (for example, resin of PVB, acrylic, or a nitrocellulose system), a solvent (for example, toluene, a xylene, a butanol), and a plasticizer (for example, the amine system organic substance, DOA) are blended with this ceramic powder, stirring mixture is fully carried out, a slurry is produced and the tape forming of the ceramic green sheet for a restraint 12 is carried out by the doctor blade method etc. using this slurry.

[0012] In this case, the compounding ratio of the binder resin to ceramic powder, a solvent, and a plasticizer is a weight ratio to ceramic powder, and it is desirable that 25 or less % of the weight and a solvent are [50 or less % of the weight and a plasticizer] 0.5 % of the weight or more for a binder resin.

[0013] That is, if there are too many loadings of a binder resin, since baking stretch of the ceramic green sheet for a restraint 12 will become large too much with the welding pressure at the time of baking, baking stretch is suppressed within proper limits by making the compounding ratio of the binder resin to ceramic powder into 25 or less % of the weight.

[0014] Moreover, if there are too many loadings of a solvent, since the amount of deflations at the time of the xeransis after the tape forming of the ceramic green sheet for a restraint 12 will become large too much, the amount of deflations at the time of xeransis is stopped within proper limits by making the compounding ratio of the solvent to ceramic powder into 50 or less % of the weight.

[0015] Moreover, if there are too few loadings of a plasticizer, since it will dissociate with a solvent and it will stop acquiring sufficient plasticity, by making the compounding ratio of the plasticizer to ceramic powder into 0.5 % of the weight or more, it is made to fully mix with a solvent and a required plasticity is secured.

[0016] in carrying out pressurization baking of the low-temperature baking ceramic substrate 11 using the ceramic green sheet for a restraint 12 of the above composition, it is shown in drawing 1 -- as -- both sides of the low-temperature baking ceramic substrate 11 -- the ceramic green sheet for restricted layers 12 -- ** -- the top to 2-20kgf/cm² It calcinates at 800-1000 degrees C (preferably 900 degrees C) which is the sintering temperature of the low-temperature baking ceramic substrate 11, pressurizing by the pressure. In this case, since it is not sintered unless it heats the ceramic green sheet for a restraint 12 (MgO, ZrO₂, etc.) by which the laminating was carried out to low-temperature baking ceramic substrate 11 both sides at 1500 degrees C or more, if it calcinates at 800-1000 degrees C, the ceramic green sheet for a restraint 12 will be left behind with not sintering. However, in process of baking, the solvent and resin binder in the ceramic green sheet for a restraint 12 disperse, and it remains as a ceramic powder.

[0017] A wet blast (water jet) or a dry-type blast removes the residue (ceramic powder) of the ceramic green sheet for a restraint 12, adhering to both sides of the low-temperature baking ceramic substrate 11 after pressurization baking. The projection material

used for wet [this] or dry-type blast processing is the degree of hardness of the ceramic material of the ceramic green sheet for a restraint 12, an EQC, or a degree of hardness beyond it, and the ceramic powder of the degree of hardness of the low-temperature baking ceramic substrate 11, an EQC, or the degree of hardness not more than it is used for it. For example, when the ceramic green sheet for a restraint 12 is MgO (Mohs hardness:6) and the ceramic green sheet for a restraint 12 of projection material is ZrO₂, using the fine particles of MgO (Mohs hardness:8), projection material is MgO or ZrO₂. Fine particles are used.

[0018] At a wet blast, projection material is injected to the site for elimination by the hyperbaric pressure stream, by the dry-type blast, projection material is injected to the site for elimination by the hyperbaric pressure airstream, and the residue (ceramic powder) of the ceramic green sheet for a restraint 12 adhering to both sides of the low-temperature baking ceramic substrate 11 is removed. the case of for example, a wet blast (water jet) -- ~~the projection material is carried out~~ -- carrying out -- ***** -- ~~for example,] **~~ -- it carries out, the bearer rate of a product is considered as a part for 0.2m/, and projection material is injected This condition is an example and cannot be overemphasized by that you may change suitably.

[0019] After blast processing, the buffing of the front face of the low-temperature baking ceramic substrate 11 is carried out, and it is finished. Using a polishing ring (buff), this buffing attaches an abrasive material (for example, SiC) to the front face, rotates a polishing ring by about 2000 rpm, it pushes this polishing ring against the front face of the low-temperature baking ceramic substrate 11, finishes it, and grinds it (about [machined surface granularity:#1500]).

[0020] After a buffing end, after performing an alkaline degreasing and hydrochloric-acid washing as plating pretreatment, nickel / Au plating is performed to the conductor of the front face of the low-temperature baking ceramic substrate 11. Now, the manufacturing process of the low-temperature baking ceramic substrate 11 is completed.

[0021]

[Example] Since the degree of hardness of the ceramic layer for a restraint and the degree of hardness of projection material performed the blast examination which considers the influence which it has on the elimination nature of the ceramic layer for a restraint, and the flat nature on the front face of a substrate when carrying out blast processing of the low-temperature baking ceramic substrate which carried out pressurization baking, this invention person shows the test result in the next table 1.

[0022]

[Table 1]

サンプル No.	拘束用セラミック		ブラスト投射材		除去性	平坦性
	材料	モース硬度	材料	モース硬度		
1	Al ₂ O ₃	9	CaCO ₃	3	×	測定不可
2	Al ₂ O ₃	9	MgO	6	×	測定不可
3	Al ₂ O ₃	9	Al ₂ O ₃	9	○	×
4	ZrO ₂	8	CaCO ₃	3	×	測定不可
5	ZrO ₂	8	MgO	6	△	○
6	ZrO ₂	8	ZrO ₂	8	○	○
7	MgO	6	CaCO ₃	3	×	測定不可
8	MgO	6	MgO	6	○	○
9	MgO	6	ZrO ₂	8	○	○

[0023] The Mohs hardness of the low-temperature baking ceramic substrate which carried out pressurization baking by this examination is 8. The alumina (Mohs hardness:9) was used for the material of the ceramic for a restraint by sample No.1-3, and MgO (Mohs hardness:6) was used for it by ZrO₂ (Mohs hardness:8) and sample No.7-9 sample No.4-6.

[0024] moreover, the material of projection material -- sample No.1, and 4 and 7 -- CaCO₃ (Mohs hardness:3), sample No.2, and 5 and 8 -- MgO (Mohs hardness:6) and sample No. -- by ZrO₂ (Mohs hardness:8) and sample No.3, the alumina (Mohs hardness:9) was used 6 and 9 The wet blast (water jet) was used for the blasting.

[0025] From this test result, when the Mohs hardness of projection material is lower than the Mohs hardness of the ceramic for a restraint (sample No.1, 2, 4, 5, 7), elimination capacity was bad, and could not remove completely the ceramic for a restraint on the front face of a substrate, but the ceramic for a restraint remains in a substrate front face. In addition, although elimination nature is comparatively good like sample No.5 even if the degree of hardness of projection material is somewhat lower than the degree of hardness of the ceramic for a restraint since the die releasing with a low-temperature baking ceramic substrate is good when the ceramic for a restraint is ZrO₂ (Mohs hardness:8), in this test condition, a part of ceramic for a restraint remains in a substrate front face.

[0026] On the other hand, when the Mohs hardness of projection material was the Mohs hardness of the ceramic for a restraint, an

EQC, or more than it (sample No.3, 6, 8, 9), elimination nature is good and was able to remove completely the ceramic for a restraint on the front face of a substrate. This test result shows things that the degree of hardness of projection material should just be the degree of hardness of the ceramic for a restraint, an EQC, or more than it, in order to make elimination nature good.

[0027] Moreover, about the flat nature of the low-temperature baking ceramic substrate after blast processing, sample No.1 which poor elimination of the ceramic for a restraint produced, and become [a substrate front face / flat] 2, 4 and 7 are clear, and they were not able to be measured because of the elimination remainder of the ceramic for a restraint. In addition, the ceramic for a restraint is ZrO₂. If there are few residues of the ceramic for a restraint like sample No.5 (projection material is MgO) even when a part of ceramic for a restraint remains in the substrate front face since the die releasing with a low-temperature baking ceramic substrate is good, a buffing can remove the ceramic for a restraint in a case completely, and the flat nature on the front face of a substrate can be secured to it.

[0028] On the other hand, even when the elimination nature by blast processing is good, the flat nature on the front face of a substrate does not necessarily become good. That is, in sample No.3, since the alumina (Mohs hardness:9) used as projection material was a material harder than a low-temperature baking ceramic substrate (Mohs hardness:8), a substrate front face will be shaved off by ***** of projection material, and the flat nature on the front face of a substrate became poor.

[0029] On the other hand, the substrate front face by blast processing deleted, and **** did not occur, but the flat nature on the front face of a substrate was good at sample No.6 whose degree of hardness of projection material is the degree of hardness of a low-temperature baking ceramic substrate, an EQC, or a degree of hardness not more than it, and 8 and 9. This test result shows things that the Mohs hardness of projection material should just be the degree of hardness of a low-temperature baking ceramic substrate, an EQC, or a degree of hardness not more than it, in order to make good flat nature on the front face of a substrate.

[0030] If the above test result is considered synthetically, in order to make good the both sides of the elimination nature of the ceramic layer for a restraint, and the flat nature on the front face of a substrate, it is necessary to fulfill the following conditions. If this condition is fulfilled whenever [** / of the degree-of-hardness \leq low-temperature baking ceramic substrate of the degree-of-hardness \leq projection material of the ceramic layer for a restraint], both the elimination nature of the ceramic layer for a restraint and the flat nature on the front face of a substrate can be satisfied.

[0031]

[Effect of the Invention] So that clearly from the above explanation by the manufacture technique of the ceramic substrate of this invention Since it was set as the degree of hardness of the degree-of-hardness \leq ceramic substrate of the degree-of-hardness \leq projection material of the ceramic layer for a restraint, and blast processing removed the ceramic layer for a restraint on the front face of a substrate after carrying out pressurization baking While the ceramic layer for a restraint is well removable after pressurization baking, by projection material, it can prevent that the front face of a ceramic substrate will be shaved off, flat nature on the front face of a substrate can be made good, and a quality ceramic substrate can be well manufactured by the pressurization calcinating method.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] Drawing of longitudinal section showing the laminating status of the ceramic green sheet for a restraint at the time of pressurization baking in the 1 operation gestalt of this invention, and a low-temperature baking ceramic substrate

[Description of Notations]

11 -- A low-temperature baking ceramic substrate (ceramic substrate), 12 -- Ceramic green sheet for a restraint (ceramic layer for a restraint).

[Translation done.]